United States
Department of
Agriculture

**Food Safety
and Inspection
Service**

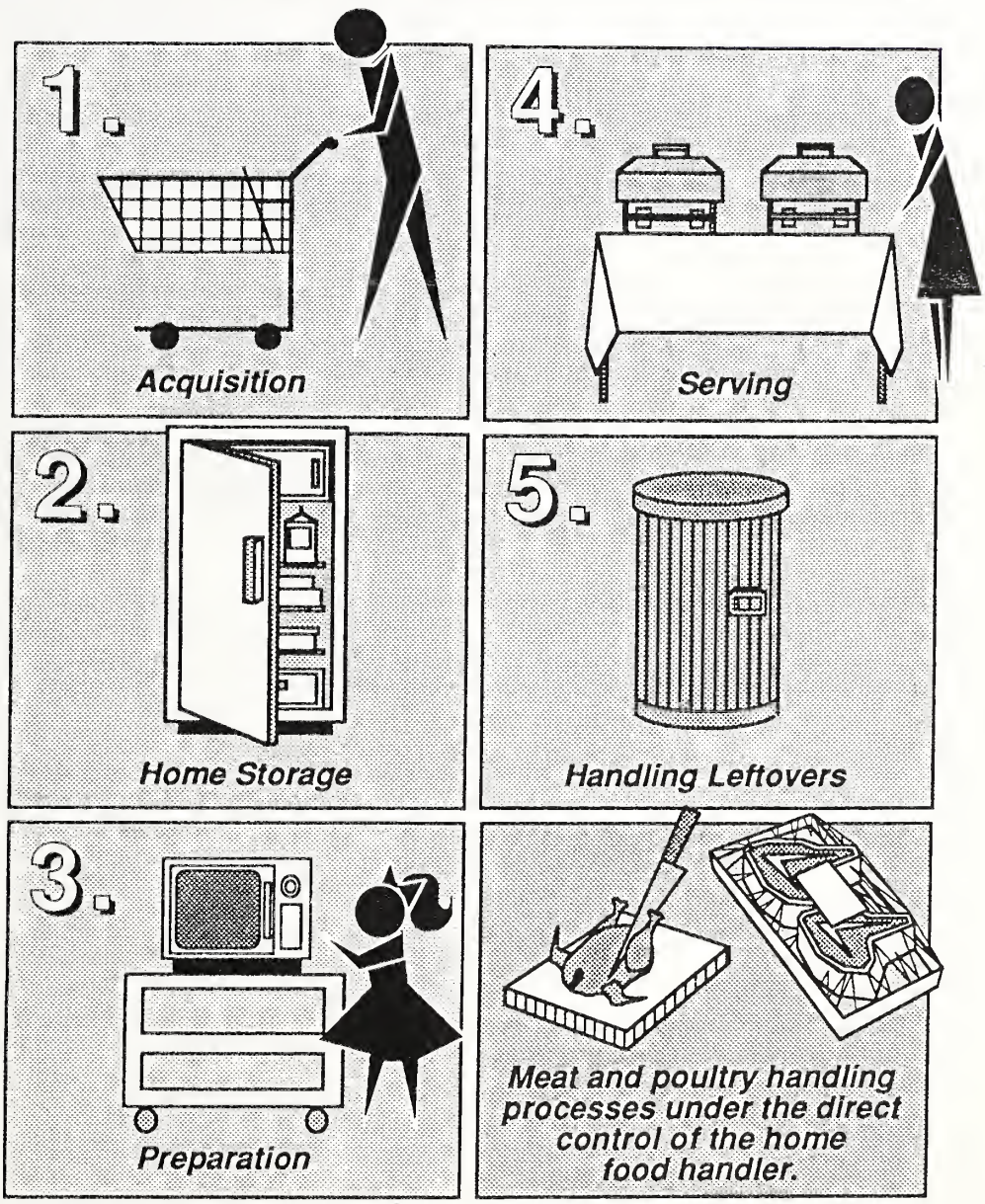
Information and
Legislative Affairs

Reprinted
March 1990

A Margin of Safety: The HACCP* Approach to Food Safety Education

Summary Report

*Hazard Analysis of Critical Control Points



Preface

Between the autumn of 1987 and the winter of 1988-1989, the working group on risk-based food safety education synthesized information from a literature search and several surveys of experts in a reassessment of the appropriate content of Food Safety and Inspection Service (FSIS) education programs for home food handlers. This was done, in part, in response to a suggestion of the National Academy of Sciences that FSIS food safety education programs might be more "systematic."

Hazard Analysis of Critical Control Points (HACCP) theory involves taking a closer look at a process to determine the critical control points. The critical control points are those where a failure to take an appropriate action will be most likely to jeopardize the outcome or product of the process. Using the most objective measures available, the group sought to apply this approach to food safety education — to determine educational critical control points, or those behaviors most important in preventing meat or poultry borne illness, but least understood.

The first use of the project results will be a new consumer education publication to supplement the popular Safe Food Book. Project results will also be used in the revision of the latter publication, which FSIS will target primarily to "information multipliers" such as Extension agents, teachers, local health officials, and journalists. Finally, FSIS will continue to use a more systematic, risk-based approach in future food safety education programs.

This project does not downplay the importance of microbial contamination, which is a critical control point in the prevention of bacterial foodborne illness. FSIS has many times expressed its policy that the animal production and food processing industries must work together to control and reduce the frequency of microbial contamination throughout the food chain.

Nevertheless, microbial contamination of raw products should not be portrayed as the single most important control point in preventing illness. Food handling practices almost always determine whether microbial contamination on raw products results in foodborne illness.

Today, almost all cases of bacterial foodborne illness could be prevented by careful food handling. If microbial contamination on raw foods of animal origin is significantly reduced (it cannot be eliminated unless foods are sterilized), careful food handling will still be necessary to prevent bacteria from surviving, reproducing, or, in some cases, forming toxin.

This is a summary report. Readers interested in more information about this project may request a copy of the full report and appendixes from:

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Working Group on Risk-Based Food Safety Education

"A Margin of Safety" summarizes a project coordinated by the Information and Legislative Affairs Staff (ILA) of the Food Safety and Inspection Service between the autumn of 1987 and the winter of 1988-89. It involved the time and expertise of professionals from several other FSIS staffs, including Science, Technical Services, and the Policy and Planning Staff. The core group responsible for the analysis and report includes:

Sharin Sachs, (now chief, Information Office, ILA)
Carl Custer, chair, microbiology subcommittee (staff officer, Processed Products Division, Technical Services)
Priscilla Levine, microbiology subcomittee (microbiologist, Microbiological Monitoring and Surveillance Branch, Microbiology Division, Science)
Martha Workman, microbiology subcommittee (food technologist, Nutrition Branch, Food Ingredient Assessment Division, Science)
Marjorie Davidson, chair, public awareness subcommittee (assistant chief, Public Awareness Office, ILA)
Sara Fein, survey analyst (program analyst, Policy Analysis Unit, Policy and Planning Staff)
Milton Goldsamt, questionnaire design (formerly program analyst, Policy Analysis Unit, Policy and Planning Staff)

Acknowledgments

The work of many other individuals helped to shape the project and to ensure that results are applicable to the food safety education programs of the Food Safety and Inspection Service. First, of course, are the experts who took time out of their busy schedules to complete the survey questionnaires and to provide honest, thoughtful comments. The experts include several members of the National Advisory Committee on Microbiological Criteria for Foods, whose interest in the project is greatly appreciated; 11 experienced microbiologists in government, academia, and the private sector; 7 knowledgeable consumer advisors in government, industry, and the private sector; and 3 epidemiologists with the FSIS Meatborne Hazard Control Center.

Susan Templin, coordinator of USDA's Tollfree Meat and Poultry Hotline, and several members of her staff helped develop the inventory of advice statements and offered useful suggestions throughout the course of the project. Jane Roth, director of the Policy Analysis Unit, provided many pertinent, concise suggestions for professionally sound analysis. Dr. Catherine Adams, special assistant to the Administrator, FSIS, participated in designing and pretesting the survey instrument. Jody Siegel helped shape the conceptual design of the project. Laura Fox, chief of the Public Awareness Office, and Karen Stuck offered many useful suggestions. Finally, Patricia Drayne quietly and consistently provided sound guidance and sage advice on all aspects of the project.

Contents

Executive Summary

Background

An estimated 6.5 to 81 million cases of foodborne illness occur each year. (No one knows how much foodborne illness actually occurs.) At least 25 percent of reported foodborne illness outbreaks could have been prevented solely by safe food practices. In about 25 percent of preventable outbreaks of foodborne illness, a meat or poultry product was the food "vehicle" for the bacteria that caused illness.

Foods don't cause illness; bacteria and other pathogens do. However, raw foods of animal origin — meat, poultry, eggs, fish, shellfish — frequently are contaminated with Salmonella or other bacteria common in the food chain. In other cases, healthy food handlers may contaminate food with *Staphylococcus aureus* or other bacteria common in the human body, or diseased food handlers may contaminate food with less common pathogens.

Whether raw foods are contaminated at the time of purchase or purchased foods are contaminated by food handlers, over time, mishandling can allow bacteria to survive, reproduce, or (in some cases) form a toxin in food or the human body. In short, food handling errors are almost always directly associated with the "dinnerplate" microbial contamination that is a prerequisite for foodborne illness.

A 1983 survey found that consumers rate homes last as a place where food safety concerns occur. Indeed, more reported outbreaks are traced to commercial foodservice settings than to either homes or food processing establishments. However, between 1973 and 1982, home food mishandling contributed to at least 345 outbreaks of foodborne illness. (Except for botulism, an outbreak usually affects at least two persons.)

It is widely acknowledged that education of food handlers (in all food handling settings) can reduce foodborne illness by positively influencing behavior. That is because careful food handling provides a wide margin of safety from foodborne illness. However, the seemingly straightforward task of food safety education is more complicated than it may first appear.

In one of many activities to increase the effectiveness of food safety education, the Working Group on Risk-based Food Safety Education in 1987 and 1988 reassessed the focus of the Food Safety and Inspection Service's educational outreach programs for home food handlers.

Goals

-Support sound educational priorities and objectives;

-Contribute to the future revision of all ILA consumer education materials, including such major publications as the Safe Food Book; and

-Respond to the recommendation of the National Academy of Sciences (NAS) that ILA food safety education programs be more "systematic."

Objectives

-Define the meat and poultry handling process under the direct control of the home food handler, including all specific behaviors known or believed to be important in preventing bacterial and parasitic foodborne illness (the preventable foodborne illnesses);

-Determine the specific behaviors most important in preventing meat or poultry-borne illness, and least understood or practiced.

Method

The group (1) conducted a literature search, including a survey of surveys on consumer knowledge and practice of important food safety practices; (2) surveyed 11 selected microbiologists with an average of 22 years' experience and 10 members of the National Advisory Committee on Microbiological Criteria; and (3) surveyed 7 consumer experts.

Microbiology experts were asked to assess the risks of not performing about 77 behaviors known or believed to be important in preventing foodborne illness, for two product categories (raw or partially cooked, and fully cooked). Consumer experts were asked to assess home food handler knowledge and practice of the behaviors. All information on knowledge and practice was analyzed and cross-referenced.

Findings

Handling practices. The working group synthesized the information from the literature search and surveys of microbiology experts to develop a list of meat and poultry handling practices most important in preventing foodborne illness. (See "Red Light, Yellow Light," following the executive summary.)

Knowledge and practice. The working group synthesized the information from the literature search and survey of consumer experts to summarize apparent food handler knowledge and practice of meat and poultry handling behaviors most important in preventing foodborne illness.

Available epidemiological information shows where some of the mistakes were made..

-Undercooking was a factor in 108 (31.3 percent) of 345 home outbreaks of foodborne illness that occurred between 1973 and 1982 (involving all foods, not just meat and poultry).

-Improper cooling was a factor in 77 home outbreaks (22.3 percent of the 345).

-Cooking foods ahead — 12 or more hours before serving — was a factor in 44 home outbreaks (12.8 percent of the 345). (Cooking ahead in itself is not a mistake. In the 44 outbreaks, at least one other mistake must have been made — such as undercooking — that allowed bacteria to survive. The time lag between preparation and serving simply allowed bacteria more time to reproduce or, in some cases, form toxin.)

Source: "Risks of Practices, Procedures and Processes that Lead to Outbreaks of Foodborne Diseases," Dr. Frank Bryan. Journal of Food Protection (Vol. 51, No. 8), August 1988.

Recent consumer survey results provide a perspective on both home food handler knowledge and practice of several handling steps important in preventing bacterial foodborne illness.

-About 25 percent of home food handlers would only rinse or wipe their hands after handling raw meat or poultry.

-About 25 percent would only rinse or wipe a cutting board or knife after use with raw meat or poultry.

-27 percent of home food handlers would thaw a turkey on the counter.

-44 percent never use a meat thermometer or pop-up timer for turkeys.

-25 percent would serve undercooked (rare or pink) hamburgers.

-14 percent would leave cooked food at room temperature more than 2 hours.

-67 percent would refrigerate cooked food in the cooking pot or one large container.

-12 percent think fried chicken left on counter overnight would be safe to eat without reheating; 14 percent think reheating would make it safe to eat.

(Source: Preliminary results from 1988 FDA Health and Diet Survey Cycle IV.)

Unfortunately, too little objective, current information is available on consumer food safety knowledge and practice. However, surveyed consumer experts believe that more than half of American home food handlers do not understand or practice several food handling steps that are crucial in preventing foodborne illness.

Themes that Deserve More Emphasis in Food Safety Education

The group identified a list of themes appropriate for greater emphasis in FSIS educational programs, based on (1) the risk of not performing the practice and (2) the knowledge and practice of home food handlers. (Also see "Red Light, Yellow Light.")

Most striking is the need for greater emphasis on practices that promote rapid, even cooling; specifically, using shallow containers and breaking roasts or other large cuts into smaller pieces. Improper cooling is the most common mistake made in all foodborne illness outbreaks — not just in homes, and not just involving meat or poultry.

Two improper cooling behaviors predominate: leaving cooked foods at room temperature too long, and refrigerating foods in large, deep containers. A nationwide survey of consumers with telephones shows that 67 percent would refrigerate cooked foods in the cooking pot or one large container, and 14 percent would leave cooked foods at room temperature for more than 2 hours.

If all food safety educators emphasized rapid, even cooling for the next year, the project team believes this single action could reduce preventable foodborne illness, by positively affecting food handler behavior.

Following is a list of other themes that warrant more attention in FSIS food safety education materials, based on project results.

The most important food handling behaviors are those which will, most of the time, protect most consumers from the foodborne illnesses of most public health concern.

Every failure to perform an important food handling behavior increases the risk of foodborne illness.

The importance of safe food handling increases for food consumers who are very young, very old, ill, malnourished, or whose immune systems are weak ened. (FSIS has begun an educational campaign directed at consumers in these high-risk categories.)

Separate raw meat or poultry (or fish, or eggs) from cooked foods or foods that will be eaten without further cooking.

Report food safety problems.

Cool hot foods fast and evenly.

It is risky to eat any food of animal origin either raw or rare.

It may be even riskier to eat cooked foods that have been left out too long, cooled too slowly, or incompletely reheated.

Fast cooking: Take special precautions to ensure even, complete cooking and reheating in microwave ovens.

Slow cooking: Take special precautions to ensure even, complete cooking in slow cookers and smokers.

A meat thermometer or microwave temperature probe is the best "cue for doneness." Without one, check for clear-running juices and the absence of pink in the center of meat or poultry.

Refrigeration and freezing do not destroy bacteria and, therefore, cannot cancel out other mistakes such as incomplete cooking or leaving cooked foods out too long. Take special care with leftovers, or when preparing foods ahead for later serving.

What to do when the power goes out — on refrigerators, freezers, and freezer compartments.

For food safety, follow open dating guides on labels.

If the recipe, product cooking instruction, or appliance direction seems unwise — check it out. Call the Tollfree Meat and Poultry Hotline at 1-800-535-4555, 10 a.m. to 4 p.m., EST. TDD-accessible.

Care labeling

Project results suggest that more manufacturers may wish to consider adding "care labeling" — that is, cooking and storage instructions — to all products that require refrigeration before or after opening. Although experts did not agree on the impact care labeling would have on proper food handling and a subsequent reduction in foodborne illness, almost all believe that cooking and storage instructions on product labels would have a positive effect. (FSIS policy requires "special care" labeling on certain types of products, such as those that require refrigeration.)

Open dating

Open dating appears to be evolving from a quality issue to a time-temperature safety issue, particularly for ready-to-eat refrigerated foods. FSIS encourages refrigerated storage at 40 degrees F or lower, and encourages States to enforce open dating requirements. Some companies are now experimenting with time-temperature monitors in conjunction with open dating.

Food safety issues

The project on risk-based food safety education asked two groups of food safety experts to identify the greatest microbiological food safety concerns of the next 5 years. The groups identified several important concerns (in approximate priority order).

(1) *Salmonella*
(2) *Listeria monocytogenes*
(3) Training of commercial food handlers
(4) Education of home food handlers
(5) Products in vacuum, mixed-atmosphere, or other novel packaging
(6) Partially cooked products
(7) Refrigerated products
(8) *Campylobacter jejuni*
(9) *E. coli* 0157:H7

Red Light, Yellow Light: Essential and Advised Behaviors to Prevent Foodborne Illness from Meat and Poultry

The following handling practices are important in preventing foodborne illness because they prevent or control the "dinnerplate" microbial contamination intrinsically associated with foodborne illness. The practices are under the direct control of the consumer, from food acquisition through disposal.

If colors were used, a red light by "essential" behaviors would signify that the **risk of foodborne illness is high until the behavior is carried out.** A yellow light by "advised" behaviors would signify that food handlers **may** be taking a risk of foodborne illness if the behavior is not carried out.

PROCESS 1: *Acquisition*

Essential:

***Keep packages of raw meat and poultry separate from other foods, particularly foods that will be eaten without further cooking. For example, use plastic produce bags on fresh fruits and vegetables. Consider using plastic bags to enclose individual packages of raw meat and poultry. Avoid placing raw meat or poultry in the cart in a manner that will allow fluids to drip on other foods.**

*Buy packaged precooked foods only if packaging is sound; for example, no tears in packaging.

*Buy products labeled "keep refrigerated" only if they are stored in a refrigerated meat case.

*Buy unpackaged meat or poultry from deli refrigerated cases only if not in contact with other foods.

*Shop for meat and poultry last. Within 2 hours, serve, reheat, refrigerate or freeze cooked foods — within 1 hour if it's hot out.

*Report problems with packaging, product, storage, or sanitation to store management. If still unsatisfied, report problem to local health authorities.

Advised:

#Buy open-dated products only if label "sell-by", "use-by" or "pull-by" date has not expired. (If asked today, some experts might rate this as a critical food handling behavior.)

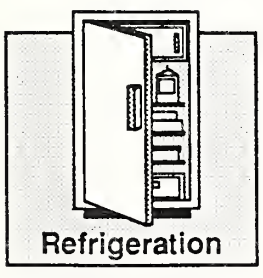
#Plan ahead to make sure you have enough refrigerator or freezer space for your meat and poultry purchases.

#Buy foods from reputable source with no known record of unsafe handling.

#Buy frozen products only if they are frozen to the touch.

#Pack raw foods in an ice chest if time from store to home refrigerator will be more than 1 hour.

PROCESS 2: *Home Storage*



Essential:

*Keep raw meat or poultry separate from other foods, particularly those that will be eaten without further cooking. Use plastic bags or aluminum foil over commercial packaging on meat or poultry, or place product on plate, to prevent raw juices from dripping on other foods or refrigerator surfaces.

*Refrigerate products with "keep refrigerated" labels.

*If refrigerator fails, keep door closed and, within a few hours, cook products or place in environment 40 degrees F or colder. Because refrigerator and climate conditions may vary a great deal, call the Tollfree Meat and Poultry Hotline for specific advice in your situation: 1-800-535-4555.

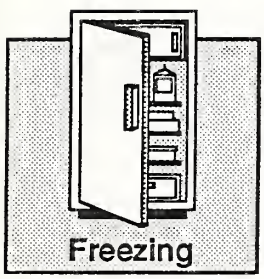
Advised:

#Use refrigerator thermometer to verify temperatures of 40 degrees F or colder.

#Maintain a clean refrigerator.

#Wash hands with soap and water for 20 seconds before rewrapping products whose packaging was damaged during transport.

#Use undated products within a safe time limit that will also ensure quality. Dating undated products at home is a good idea.



Essential:

***If freezer fails, keep door closed. Within 1 to 2 days, refreeze meat and poultry with ice crystals. If freezer compartment of a refrigerator fails, keep door closed and find another cold source within a few hours, OR cook and serve the product. Because freezer and climate conditions can vary a great deal, call the Tollfree Meat and Poultry Hotline for specific advice if this happens to you.**

Advised:

#Freeze foods with a "keep frozen" label.

#Use freezer wrap, freezer-quality plastic bags, or aluminum foil over commercial wrap on products for the freezer.

#Wash hands with soap and water for 20 seconds before rewrapping product whose packaging was damaged in transit.

PROCESS 3: *Preparation*

Essential:

***Wash hands (gloved or not) with soap and water for 20 seconds before beginning preparation, after handling raw meat or poultry, after touching animals, after using bathroom, or after changing diapers.**

***Don't let juices from raw meat or poultry come in contact with any other food, raw or cooked. Wash your hands, counters, equipment, and utensils with soap and water immediately after use. (Examples: Acrylic cutting boards are easier than wooden cutting boards to keep clean; don't reuse marinades.)**

*Thaw only in refrigerator, under cold water changed every 30 minutes, or in microwave (followed by immediate cooking).

*Stuff raw product immediately before cooking. USDA advises against purchase of fresh, prestuffed whole poultry. USDA advises purchase of fully cooked, prestuffed whole poultry only if it will be served within 2 hours after purchase.

*Don't taste meat or poultry when it's raw or during cooking (or eggs, fish or shellfish — any raw food of animal origin).

Advised:

#Sneeze away from food.

#Marinate raw products in the refrigerator, not on the counter.

#Wear clean plastic glove over skin cut, particularly when handling cooked products.

Essential:

(Cooking raw products)

*Use meat thermometer to judge safe internal temperature of meat and poultry over 2 inches thick (160 degrees F or higher for meat, 180 degrees F or higher for poultry). If your microwave has a temperature probe, use it. In conventional cooking, particularly for consumers without meat thermometers, USDA advises oven temperatures of 325 degrees F or above. For microwaving, USDA advises consumers to cover raw meat and poultry, and to check temperature of microwaved meat and poultry in at least three spots.

*For meat or poultry less than 2 inches thick, look for clear juices and lack of pink in the center as signs of "doneness."

*USDA advises consumers who use slow cookers or smokers to start with fresh rather than frozen, smaller chunks rather than roasts or large cuts, and to be sure the recipe includes a liquid. Also, check internal temperature in three spots to be sure food is thoroughly cooked to 160 degrees F.

(Both cooking raw products and reheating processed products)

*Avoid interrupted cooking. Never refrigerate partially cooked products to later finish cooking them on grill or in oven. USDA also advises against recipes that call for "cooking without a heat source." For example, boiling water, inserting poultry, turning off water; preheating oven to 500 degrees F, inserting roast, turning off oven.

*If microwave cooking Instructions on product label are not appropriate for your microwave, Increase microwave time for product to reach safe internal temperature.

*Use rotating microwave pad or rotate foods manually during microwaving.

*Let microwaved food stand for recommended number of minutes before serving.

PROCESS 4: *Serving*

Essential:

*Wash hands with soap and water before serving or eating food. Serve cooked products on clean plates and with clean utensils and clean hands. For example, never put barbecued chicken back on the platter that held raw chicken.

Advised:

#Avoid dipping personal spoon in serving dish.

Hot Holding

Essential:

*Hold hot food above 140 degrees F.

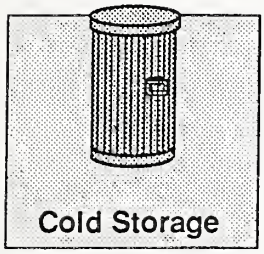
Room temperature holding

Essential:

*In environmental temperatures 90 degrees F or warmer, leave out cooked food no longer than 1 hour before reheating OR refrigerating or freezing.

*In environmental temperatures below 90 degrees F, leave out cooked food no longer than 2 hours before reheating OR refrigerating or freezing.

PROCESS 5: *Handling Leftovers*



Essential:

*Wash hands before handling leftovers and use clean utensils and surfaces.

*Remove stuffing before cooling or freezing.

*Refrigerate or freeze cooked leftovers in small, covered, SHALLOW containers within 2 hours after cooking. Leave airspace around containers to help ensure rapid, even cooling. Home economists with the Tollfree Meat and Poultry Hotline suggest using containers 3 inches deep or less — the depth of a cake pan or pie dish.

*Avoid tasting old leftovers to determine safety.

Advised:

#Date leftovers to allow use within safe time period.

Reheating Cooked Leftovers

Essential:

*If reheating leftovers, cover and reheat to appropriate temperature before serving (a rolling boil for sauces, soups, gravies, "wet" foods; 165 degrees F for all others).

Disposal of Leftovers

Essential:

*If in doubt, throw it out. Discard outdated, unsafe, or possibly unsafe leftovers in garbage disposal or in tightly wrapped packages that cannot be consumed by people or animals.

Questions about food safety involving meat or poultry products?
Call USDA's Tollfree Meat and Poultry Hotline at 1-800-535-4555,
10 a.m. to 4 p.m., EST TDD-accesible.
